Research Article

Correlation Between Platelet Distribution Width and Mean Platelet Volume with Hematocrit in Dengue Hemorrhagic Fever Patients at Prof. Dr. Chairuddin Panusunan Lubis Hospital Universitas Sumatera Utara

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ABSTRACT

Background: Dengue Hemorrhagic Fever (DHF) is a dengue virus (DENV) infection through the bite of an infected mosquito that manifests clinically in the form of high fever, headache, muscle pain, nausea, and rash. Research shows that several regions in Southeast Asia, including Indonesia, will experience an increase in the incidence of dengue infection in 2050 and 2080. **Objective:** This study aims to determine the correlation between platelet distribution width (PDW) and mean platelet volume (MPV) with hematocrit (Hct) in patients with Dengue Hemorrhagic Fever (DHF) at the Prof. Dr. Chairuddin Panusunan Lubis Teaching Hospital, Universitas Sumatera Utara. **Methods:** This study was conducted with a cross-sectional design. The subjects of this study were 142 DHF patients aged > 17 years obtained from medical record data at the Prof. Dr. Chairuddin Panusunan Lubis Hospital, Universitas Sumatera Utara. Statistical analysis using the Pearson Correlation Test. **Results:** In 142 study subjects, it was found that the majority of patients were in the age range of 18-39 years (83,8%) and were male (51.4%). The majority of patients had normal PDW values (85.2%), normal MPV values (91.5%), and normal hematocrit values (59.1%). **Conclusion:** No significant correlation was found between PDW and MPV with Hct in DHF patients.

Keywords: DHF, hematocrit, MPV, PDW

1. Introduction

Dengue Hemorrhagic Fever (DHF) is an acute infectious disease transmitted through the bite of female *Aedes aegypti* mosquitoes [1]. This virus is characterized by positive-strand RNA and consists of four serotypes: DENV-1, DENV-2, DENV-3, and DENV-4 [2]. Clinical manifestations such as plasma leakage and bleeding may occur due to an abnormal immune response with a cytokine storm compensating for increased vascular permeability [3]. As of 2023, global DHF cases have reached over 5 million with more than 5,000 deaths, primarily in tropical and subtropical regions, including Southeast Asia [4]. Indonesia is one of the countries with a high DHF burden. In 2022, there were 143,266 cases and 1,237 deaths, an increase from the previous year. North Sumatra Province recorded an incidence rate of 56.54 per 100,000 population, exceeding the

national target [5]. DHF cases were reported in all districts and cities of North Sumatra, with the highest numbers recorded in Deli Serdang, Medan, and Langkat [6].

The diagnosis of DHF is not only based on the clinical manifestations of the patient but also on laboratory examinations [7]. In addition to aiding in diagnosis, laboratory tests also help determine the severity of DHF [8]. Several laboratory tests used include complete blood count, particularly hematocrit (Hct), platelet distribution width (PDW), and mean platelet volume (MPV) [9]. PDW can be one of the platelet indices where increased levels indicate higher infection severity [10]. Other studies have also shown a positive correlation between PDW levels and the clinical severity of DHF [11]. Thus, PDW can serve as a predictor of dengue infection severity [12].

The severity of dengue infection is also associated with increased MPV levels. However, previous studies have mainly focused on their correlation with clinical severity classification and have not examined their relationship with hematocrit as a marker of hemoconcentration [13]. MPV levels exceeding 9.7 have been shown to increase the risk of shock by 1.5 times in children with dengue infection [14]. Other studies have found that a decrease in platelet count is followed by an increase in MPV levels in DHF patients [15]. Other studies have also found a relationship between hematocrit levels and the clinical severity of DHF in children [16]. In DHF, hematocrit levels generally increase or decrease by $\geq$20% [17]. However, hematocrit levels in some DHF patients may vary, appearing normal, increased, or decreased [18].

This study analyzes the correlation between platelet distribution width (PDW) and mean platelet volume (MPV) with hematocrit (Hct) in DHF patients at Prof. Dr. Chairuddin Panusunan Lubis Hospital, Universitas Sumatera Utara.

2. Methods

This study is a descriptive analytic study with a cross-sectional design, utilizing secondary data from Prof. Dr. Chairuddin Panusunan Lubis Hospital, Universitas Sumatera Utara, conducted from July 2024 to October 2024. The inclusion criteria for the study were hospitalized patients aged >17 years diagnosed with dengue hemorrhagic fever (DHF) at the hospital between January 2022 and December 2023. Patients with other infectious diseases or incomplete medical records were excluded.

The study sample consisted of 142 individuals selected using the consecutive sampling method. Ethical clearance for this research was obtained from the Health Research Ethics Committee of Universitas Sumatera Utara (No. 895/KEPK/USU/2024). The variables studied included platelet distribution width (PDW), mean platelet volume (MPV), and hematocrit. The data were analyzed using SPSS software. This study employed bivariate analysis to identify correlations between two different variables. The analysis began with a data distribution test using the Kolmogorov-Smirnov test, as the sample size exceeded 50. The data in this study were found to be normally distributed, so the correlation test used was Pearson's correlation test.

3. Results

This study was conducted at Prof. dr Chairuddin Panusunan Lubis Hospital, Universitas Sumatera Utara. The sample consisted of 142 patients who met the inclusion criteria.

Table 1. Characteristics of the subjects

Characteristics	Frequency (n=142)	Percentage (%)
Age (year)		
18-39	119	83,8
40-61	14	9,9
62-84	9	6,3
Gender		
Male	73	51,4
Female	69	48,6

Table 1 shows the characteristics of the subjects based on age and gender. The majority of DHF patients were in the age range of 18-39 years, totaling 119 individuals (83.8%), followed by the age range of 40-61 years with 14 individuals (9.9%), and the least in the age range of 62-84 years with nine individuals (6.3%). DHF patients were predominantly male, with 73 individuals (51.4%), followed by females, totaling 69 individuals (48.6%)

Table 2. Characteristics of Laboratory Test

Characteristics	Frequency (n= 142)	Percentage (%)
Platelet Distribution Width		
Decrease	15	10,6
Normal	121	85,2
Increase	6	4,2
Mean ± SD	12,725 ± 2,6713	
Mean Platelet Volume		
Decrease	0	0
Normal	130	91,5
Increase	12	8,5
Mean ± SD	10,548 ± 1,0848	
Hematocrit		
Decrease	43	30,3
Normal	84	59,1
Increase	15	10,5
Mean ± SD	40,586 ± 4,8866	
Platelet		
Thrombocytopenia	81	57
Normal	61	43
Mean ± SD	95,60 ± 49,296	

Table 2 shows the characteristics of the subjects based on the results of laboratory examinations. Based on the platelet distribution width value, it shows that the majority of DHF patients have normal values , with a total of 121 people (85.2%), followed by a decreasing value of 15 people (10.6%) and an increasing value of 6 people (4.2%).

Based on the mean platelet volume value, it shows that the majority of DHF patients have normal values, with a total of 130 people (91.5%), followed by an increasing value of 12 people (8.5%) and a decreasing value of 0 people (0.0%). Based on the hematocrit value, it shows that the majority of DHF patients have normal values of 84 people (59.1%), obtained from 50 male patients (35.2%) and 34 female patients (23.9%). This is followed by patients with a decreasing hematocrit value of 43 people (30.3%) and an increasing value of 15 people (10.5%). Based on platelet values, it shows that the majority of DHF patients experience thrombocytopenia (<100,000/ µl), as many as 81 people (57%), with the remainder having normal platelets (>100,000/ µl), as many as 61 people (43%).

Table 3. Correlation Test of Platelet Distribution Width and Mean Platelet Volume with Hematocrit in DHF Patients with Platelets <100.000/µl

Variabel	Hematokrit	
	Normality Test*	Correlation test**
Platelet Distribution Width	$p= 0,2$	$p= 0,372$ $r= -0,101$
Mean Platelet Volume	$p= 0,2$	$p= 0,050$ $r= -0,219$

*Kolmogorov-Smirnov test
**Pearson Correlation Test

Table 3 shows the correlation of platelet distribution width and mean platelet volume with hematocrit in DHF patients with platelets <100.000/µl. The results of the correlation test of platelet distribution width with hematocrit using Pearson's r test obtained $p= 0.372$ and $r= -0.101$. The results of the correlation test of mean platelet volume with hematocrit using Pearson's r test obtained $p= 0.050$ and $r= -0.219$.

4. Discussion
This study shows that the dominant subject characteristics were within the age range of 18–39 years, accounting for 83.8%. This aligns with previous research that found a shift in the dengue epidemiology from

children to adults due to lifestyle changes, population growth, and climate change [19]. Based on gender, the majority of subjects were male (51.4%), supporting findings that outdoor activities during the daytime increase the risk of dengue infection [20].

The analysis results of PDW and MPV showed normal values in most patients (85.2% and 91.5%, respectively), consistent with previous studies showing that 83.1% of patients showed normal PDW values and 56.9% showed normal MPV values [11, 13]. However, in this study, laboratory samples were taken during the early febrile phase, so the increase in PDW and MPV was not significant. Hematocrit values were predominantly normal in males (68.5%) and females (47.8%), likely due to data collection during the early phase, before plasma leakage typically occurs.

The correlation between PDW and MPV with hematocrit showed a very weak negative relationship (p>0.05), supporting the assumption that platelet size heterogeneity (PDW) and mean platelet size (MPV) increase in response to thrombocytopenia without significantly affecting red blood cell concentration (hematocrit) [21, 22].

The study supports the notion that platelet destruction due to NS1 dengue infection, excessive immune responses, and increased vascular permeability may influence the relationship between platelet count and hematocrit [23]. Other studies have also shown a moderate negative correlation between platelet count and hematocrit (r = -0.279, *p*=0.019), indicating their relevance in the pathophysiology of dengue [24].

5. Conclusion
No significant correlation was found between PDW and MPV with Hct in DHF patients.

6. Data Availability Statement
The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations, but are available from the corresponding author upon reasonable request.

7. Ethical Statement
This study was approved by the Research Ethics Committee of Universitas Sumatera Utara (Ethical Clearance No. 895/KEPK/USU/2024). Sumatera Medical Journal (SUMEJ) is a peer-reviewed electronic international journal. This statement below clarifies the ethical behavior of all parties involved in the act of publishing an article in Sumatera Medical Journal (SUMEJ), including the authors, the chief editor, the Editorial Board, the peer-reviewer, and the publisher (TALENTA Publisher Universitas Sumatera Utara). This statement is based on COPE's Best Practice Guidelines for Journal Editors.

8. Authors' Contributions
All authors contributed to the design and implementation of the research, data analysis, and finalizing the manuscript.

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11. Conflict of Interest
The authors declare no conflict of interest.

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